

W91321-04-C-0023

LOGANEnergy Corp.

McEntire ANGB, SC PEM Demonstration Project
Initial Project Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY03

McEntire ANGB, SC Fire Station

10 Nov 2004

Executive Summary

Under terms of its FY'03 DOD PEM Demonstration Contract with ERDC/CERL, LOGANEnergy will install and operate a Plug Power GenSys 5kWe Combined Heat and Power fuel cell power plant at McEntire Air National Guard Base located near Columbia, SC. The site selected for the one-year demonstration project is the McEntire ANGB Fire Station. The unit will be electrically configured to provide grid parallel/grid independent service to the facility and it will also be thermally integrated with its gas-fired water to support domestic thermal loads. Local electrical and mechanical contractors may be hired as necessary to provide services needed to support the installation tasks. It is anticipated that the project will add \$197.00 in annual energy costs to McEntire during the period of performance.

The Hill AFB POC for this project is Lt. Col Nelson McLeod whose coordinates are:

Comm.: (803) 647-8606

Nelson.mcleod@scmcen.ang.af.mil

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

LOGANEnergy Corp. Small Scale PEM 2004 Demonstration Project at McEntire ANGB, SC

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Chris Davis
Title	President	Vice President Operations
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	(860) 872-1120
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	cdavis@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Chris Davis
Title	President	Vice President Operations
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	(860) 872-1120
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	cdavis@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Four-year PC25 PM Services Maintenance Agreement.

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD. .

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement on 600kW UTC PC25 power block.

Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partner LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

7.0 Host Facility Information



McEntire Air National Guard Station (ANGS) is located approximately 16 miles southwest of Columbia, South Carolina. The 2,400-acre base is owned by the US Government and is operated by the South Carolina Air National Guard. McEntire ANGS owns 2,344 acres and leases approximately 64 acres from the State of South Carolina. Additionally, there is a small parcel of privately owned land within the base boundary; however, neither the leased land nor the privately owned land contains utilities.

The South Carolina Air National Guard was formed in December 1946 and today is made up of 1,300 members who train at McEntire ANG Station. The base is home to the 169th Fighter Wing, which flies the F-16 multi-role fighter. An Army National Guard aviation unit is also a tenant on the base.

The base has a total 95 buildings: 90 industrial, 4 administrative and one services totaling 263,000 square feet. There is no family or transient housing. New facilities under construction include an addition to the avionics building (2,500 square feet) and replacement of the air traffic control tower and aircraft support equipment facility (14,600 square feet total). Additionally, seven facilities totaling approximately 21,000 square feet were demolished in FY 2001. There are 550 full-time ANG personnel on base which increases to

1300 one weekend per month. Additionally, there is a small cadre of Army personnel on base, increasing to 400 every other weekend.

McEntire Air National Guard Station is named for the late Brigadier General Bernie B. McEntire, Jr., the first commander of the S.C. Air Guard and its first general officer. General McEntire died in May 1961 when he rode his malfunctioning F-104 into the Susquehanna River to avoid crashing in the populated area of Harrisburg, PA. The base was previously known as Congaree Air Base and was used in World War II as a U.S. Marine Corps training base.

8.0 Fuel Cell Site Information



The photo at right is a picture of the rear elevation of the fire station at McEntire ANGB, the site for the PEM project. During the site evaluation performed by Mike Harvell of LOGAN and supported by Lt. Col McLeod on September 15, 2004, the parties agreed that the fire station would provide a good opportunity to install the fuel cell to best effect.

The photo below shows the Plug Power Gensys5C (See appendix section 2 for specifications) fuel cell on its pad in a niche formally occupied by a trash dumpster. The unit was delivered on October 15, 2004.

Providing gas service for the fuel cell will present a new challenge for LOGAN since its closest location is on the roof of the building, pictured at left below, some 100 feet from the unit. Fuel for the unit will be intercepted on the yellow gas line pictured in the photo below. However electrical integration with the building will be very straightforward as the electric panel is conveniently located to the fuel cell pad. The building does not currently have high speed



Ethernet service, but the POC has offered assistance to acquire the service. The installation plan will simulate a critical load application by wiring non-critical circuits in the fire station to the fuel cell's emergency load panel.

9.0 Electrical System

The Plug Power GenSys 5C PEM fuel cell power plant provides both grid parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the GenSys5 as it approaches product commercialization. The unit has a power output of 110/120 VAC at 60 Hz, and when necessary the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. At this site the unit will be connected to the facility in a grid parallel/grid independent configuration dispatching power at 2.5 kW for most of the period of performance. The photo at right shows the electrical service panel where the fuel cell will be electrically coupled to the base utility grid at a spare 50-amp circuit breaker cubicle. The electrical closet is conveniently located behind the exterior wall adjacent to the fuel cell pad site. A separate emergency panel will be installed adjacent to this service panel to provide stand-by power from the fuel cell to support several non-critical loads in the event of a grid failure during the test period. This will provide the opportunity to demonstrate the fuel cell's grid independent capability.



10.0 Thermal Recovery System

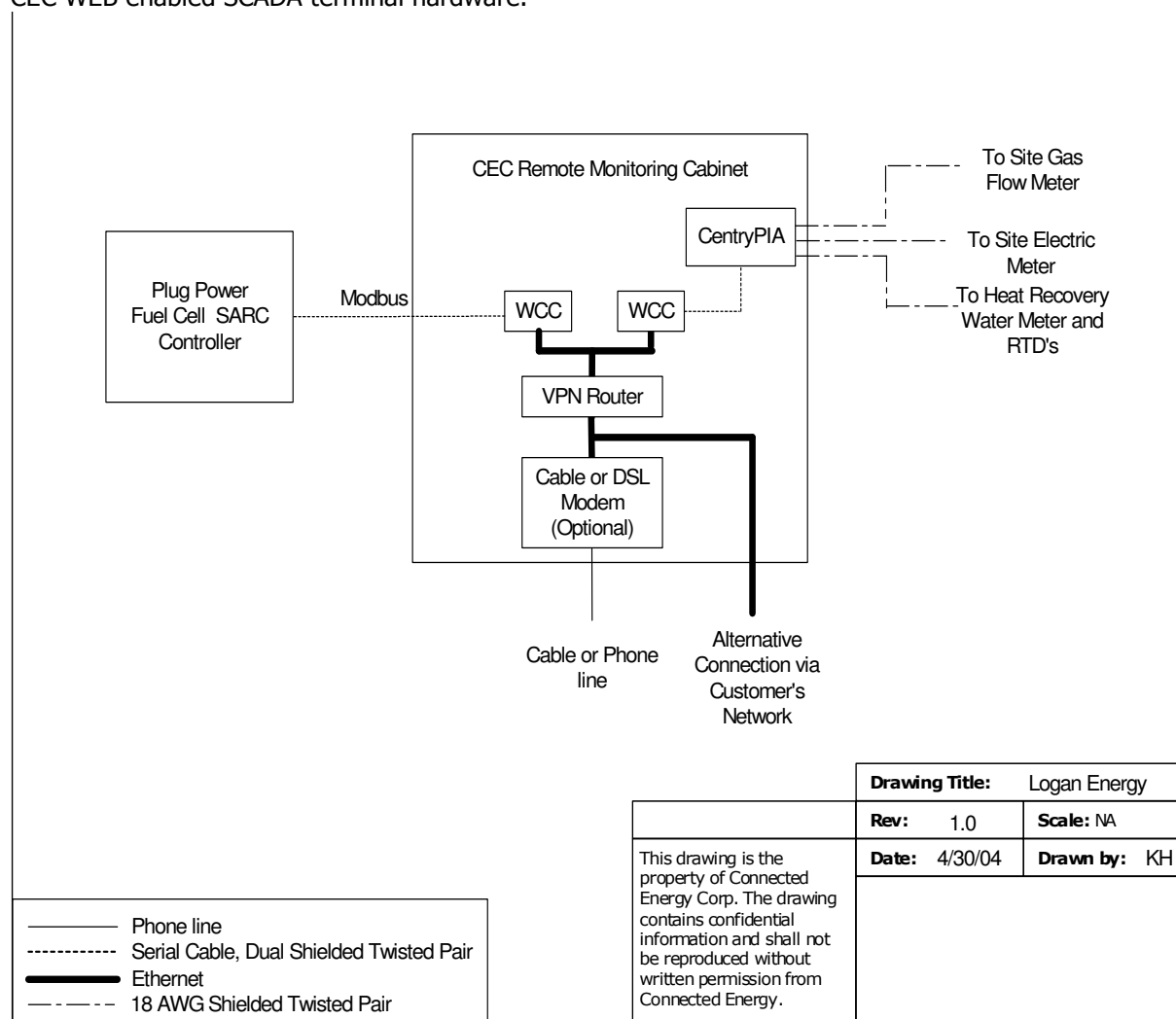
LOGAN will install a Heliodyne heat exchanger to capture fuel cell waste heat and transfer it into the fire station's hot water heater in a manner similar to the installation pictured at right. (Note the heat exchanger secured to the wall behind the hot water heater) The Heliodyne is a looped coil within a coil design that provides double wall protection between the heat source and the heat sink. It was designed primarily for the solar heating industry, but has proved to be very adaptable to the fuel cell industry, as LOGAN has used this product to good effect at several other PEM demonstration sites. The Heliodyne will mount either directly to the storage tank or on an adjacent wall. It has its own pump that circulates the storage tank in a counter flow against incoming hot water provided by a thermal loop connected to the fuel cell's heat exchanger. While operating at a set point of 2.5 kWh, the fuel cell has a heat rate of approximately 33,000 Btuh and would provide 7800 Btuh through the Heliodyne to the hot water tank.



11.0 Data Acquisition System

LOGAN proposes to install a Connected Energy Corporation web based SCADA system that provides high-speed access to real time monitoring of the power plant. The schematic drawing seen below describes the architecture of the CEC hardware that will support the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWh, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that will link the fuel cell to the center.

CEC WEB enabled SCADA terminal hardware.



LOGAN will procure high-speed Internet access to the fuel cell router from a local DSL or cable service provider. The base will provide local dial tone to a phone jack that will be conveniently located in the basement of Building 9 to provide communications with the fuel cell data modem.

12.0 Economic Analysis

McEntire ANGB

Project Utility Rates				
1) Water (per 1,000 gallons)	\$	0.45		
2) Utility (per KWH)	\$	0.07		
3) Natural Gas (per MCF)	\$	7.25		
First Cost		Estimated		Actual
Plug Power 5 kW SU-1		\$	65,000.00	
Shipping		\$	2,800.00	
Installation electrical		\$	2,275.00	
Installation mechanical & thermal		\$	6,215.00	
Metering, Instrumentation, Web Package		\$	11,830.00	
Site Prep, labor materials		\$	1,775.00	
Technical Supervision/Start-up		\$	4,000.00	
Total		\$	93,895.00	
Assume Five Year Simple Payback		\$	18,779.00	\$ -
Forecast Operating Expenses		Volume	\$/Hr	\$/ Yr
Natural Gas Mcf/ hr @ 2.5kW		0.0330	\$ 0.24	\$ 1,886.25
Water Gallons per Year		14,016		\$ 6.31
Total Annual Operating Cost				\$ 1,892.55
Economic Summary				
Forecast Annual kWh			19710	
Annual Cost of Operating Power Plant	\$	0.096	kWh	
Credit Annual Thermal Recovery Rate		(\$0.016)	kWh	
Project Net Operating Cost	\$	0.080	kWh	
Displaced Utility cost	\$	0.070	kWh	
Energy Savings (Cost)			(\$0.010)	kWh
Annual Energy Savings (Cost)			(\$197.63)	

13.0 Kickoff Meeting Information

The project kick-off meeting will occur on December 7, 2004 at McEntire ANGB. At that time Dr. Mike Binder representing CERL and Sam Logan representing LOGANEnergy, joined by Lt. Col. McLeod, will present the scope of the PEM demonstration project and the installation plan to the Civil Engineering Squadron. Any issues that cannot be resolved at the kickoff meeting will put the commencement of the installation on hold until the base POC submits a statement in writing to Dr Binder that the project is ready to begin.

14.0 Status/Timeline

See Appendix Section 4.

Appendix

Section 1.

Sample form used to qualify the fuel cell for initial start and the project acceptance test.

Installation/Acceptance Test Report

Site: McEntire ANGB, SC

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed	MH		
Stack Installed	MH		
Stack Coolant Installed	MH		
Air Purged from Stack Coolant	MH		
Radiator Coolant Installed	MH		
Air Purged from Radiator Coolant	MH		
J3 Cable Installed	MH		
J3 Cable Wiring Tested	MH		
Inverter Power Cable Installed	MH		
Inverter Power Polarity Correct	MH		
RS 232 /Modem Cable Installed	MH		
DI Solenoid Cable Installed with Diode	MH		
Natural Gas Pipe Installed	MH		
DI Water / Heat Trace Installed	MH		
Drain Tubing Installed	MH		

Commissioning Check List and Acceptance Test

TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK	MH		
SARC Name Correct	MH		
Start-Up Initiated	MH		
Coolant Leak Checked	MH		
Flammable Gas Leak Checked	MH		
Data Logging to Central Computer	MH		
System Run for 8 Hours with No Failures	MH		

Section 2

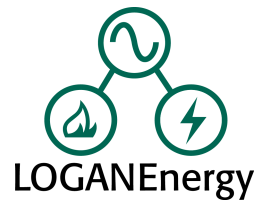
Appendix Section 2

Plug Power GenSys5C Specifications

- Dimensions 84 1/2" x 32" x 68 1/4"
- Performance Continuous Power Rating 5kW_e (9kW_{th})
Power Output 2.5-5kW_e (3-9kW_{th})
Voltage 120/240 VAC @ 60Hz
Power Quality IEEE 519, Grid Interconnect IEEE P1547
Emissions NOX <1ppm...SOX <1ppm
- Noise <60 dBA @ 1 meter
- Operating Conditions Temperature 0°F to 104°F
- Elevation 0 to 6000 feet
- Installation Outdoor
- Electrical Connection, Grid Parallel/Grid Independent
- Fuel, Natural Gas
- Certifications Power Generation, CSA International
- Power Conditioning UL 1741— Electromagnetic Compliance FCC Class B —



Section 3



DOD FUEL CELL PROJECT KICKOFF MEETING AGENDA

Date:

Location:

ATTENDEES	ORG.	PHONE	CELL	EMAIL

Status

- | | | |
|---|----|------|
| 1. Introduction, Initial Project Report, design/review installation plan: | OK | OPEN |
| 2. Discuss project objectives and core requirements: | OK | OPEN |
| 3. Discuss project/fuel cell communication requirements: | OK | OPEN |
| 4. Environmental, base access and other security issues: | OK | OPEN |
| 5. Unresolved issues...POC approval: | OK | OPEN |

Section 4

McEntire ANGB PEM Fuel Cell Demonstration Project

Installation, Monitoring, Performance Evaluations, & Reporting on One Plug Power PEM Fuel Cell At McEntire ANGB Base Fire Station

Column Headings Indicate the Beginning of Each Month

Installation Schedule

